

Branko Latinović: **Prototip ekspertnog sistema za analizu kreditnog rizika i ocjenu kreditne sposobnosti debitora**, Naučni rad, 5. Balkanska konferencija za operaciona istraživanja, Banjaluka, 5/2000. godine

## **THEME: PROTOTYPE OF EXPERT SYSTEM FOR ANALYSIS OF CREDIT RISK AND EVALUATION OF CREDIT CAPABILITY OF DEBTOR**

### **ABSTRACT**

Expert systems, i.e. their use in banking technology, produce new way of organization and behavior of the bank as a system. Namely, through substitution of some working places by use of expert systems, number of workers is being reduced, as well as their factor of subjectivity. Objective models becomes dominant and possibility of mistake is being seriously reduced. Research work at the field of development of expert system is based on the most contemporary scientific and technological knowledge and it has big importance for development of banking activity.

As the main function of a bank is approval of credits and as every credit has in itself some risk, important part of credit politics represents evaluation of credit capability of debtor, and by that mean also evaluation of the level of credit risk. Basically, level of risk accepted by a bank is resultant of its preferentions to the profitability and liquidity. To achieve a valid evaluation of credit risk and credit capability of debtor in short-term crediting of economy in this original example of expert system, it was used a combination of two well known methods of analysis of credit risk and credit capability:

- Preliminary analysis of credit risk, so called "5C" method, and
- Z-Score analysis.

The work is realized and presented on the base of scientific methodological evaluation of credit capability of debtor and implementation of the evaluation in the expert system through shell VPEXPERT.

**KEY-WORDS:** banking, software, expert systems.

## 1. CONCEPT OF ANALYSIS OF CREDIT RISK

General capability of a bank to bear a risk of operation is called solvency or adequacy of capital. In the developed economies solvency is a measurement of capability of a bank to ensure paying back of loaned financial means in long term, i.e. to ensure payment of its creditor at the moment of liquidation. Measurement of solvency of a bank in fact credit capability of the bank or its acceptability for depositors and creditors and adequacy of capital in regard to risk of loss.

As the main function of a bank is approval of credits and as every credit has in itself some risk, important part of credit politics represents evaluation of credit capability of debtor, and by that mean also evaluation of the level of credit risk. Basically, level of risk accepted by a bank is resultant of its preferentions to the profitability and liquidity.

To achieve a valid evaluation of credit risk and credit capability of debtor in short-term crediting of economy in this original example of expert system, it was used a combination of two well known methods of analysis of credit risk and credit capability:

- Preliminary analysis of credit risk, so called "5C" method, and
- Z-Score analysis.

**Analysis of credit capability of debtor** represents a foundation on which should be based and from which should be drawn evaluation of debtor's credit capability. It includes debtor's occurrence connected with the past and the present, as well as future conditions of business milieu of debtor, proportional with the period of crediting. American business banking analysis with this analysis five factors of debtor's credit capability and calls them "5Cs of credit" or shortly "5C", where the first three factors are favored. These factor are:

- Character
- Capacity
- Capital
- Collateral
- Conditions.

**Character of debtor** in contemporary context understands properties of debtor or loan applicant

connected with its business reputation, belonging to business group and legal status. The character is being divided in four elements:

- Responsibility (properties of managers and owners of company)
- Integrity (own and other business experiences with the debtor)
- Accuracy (accuracy in fulfillment of obligations)
- Consistency (Stand of business books).

In our analysis each of above mentioned elements is being valued in three degrees (excellent, good, bad).

**Capacity of debtor** represents its capability to pay back approved credit. It is based on the following elements:

- Liquidity of debtor,
- Operational efficiency of the company,
- Rentability of debtor,
- Debt of debtor.

Liquidity of debtor, in case of short-term crediting, understands the base criteria in evaluation of credit capability of debtor. Liquidity is defined as debtor's ability to discharge its obligations properly. Basic indicators of liquidity are the rate of current assets and the rate of financial assets.

$$\text{Rate of current assets} = \frac{\text{Current assets}}{\text{Current obligations}}$$

$$\text{Rate of financial assets} = \frac{\text{Current assets - stock}}{\text{Current obligations}}$$

In dependence on values of the coefficients of liquidity debtor may have excellent, good or bad liquidity.

Operational efficiency of the company is evaluated from average turnover of debtor, with supposition that the debtor with higher coefficient of turnover forms bigger pay-back potential and it has lower need for additional financial resources. It means

that the bank in eventual credit relations with the debtor has lower risk. Indicators of operational efficiency are given in the following relations:

$$\text{Average turn over of stock reserves = (Coefficient stock turnover)} = \frac{\text{Annual realization}}{\text{Average volume of reserves}}$$

$$\text{Operational efficiency of demands = (Conversion of demands into cash)} = \frac{\text{Annual realization}}{\text{Average business demands}}$$

In dependence on values of coefficient debtor has excellent, good or bad mark for the operational efficiency of the company.

Rentability of the company is especially important indicator for long-term crediting, but it has its role also in short-term crediting. This indicator measures rentability of debtor in order to direct credit resources to the most successful companies. The rentability is being expressed by the rate of nto profit. Nto profit is calculated by reducing of total income with expenses and taxes:

$$\text{Rate of nto profit} = \frac{\text{nto profit}}{\text{realization}}$$

In dependence on value of rate of nto profit the mark for the rentability can be excellent, good or bad.

Debt of the debtor is quantitative indicator of credit risk of the bank. It is being expressed by rate of debt:

$$\text{Rate of debt} = \frac{\text{Debts}}{\text{Assets}}$$

In dependence on value of rate debt system treats the debt of the debtor as good or bad.

**Capital of debtor** is defined as permanently invested means of founder and stockholders. This is in fact financial value of purchaser, i.e. its company and it is being measured as net value of the owner's property. It can be calculated when total financial means (assets) is reduced by total obligations

(liabilities). Here into account should be taken that bookkeeping value does not reflect market value. Debtor's property is the highest limit of the credit and assurance for pay-back of the credit. In our example it can have two values: yes or no.

**Collateral of debtor** represents providing of the credit and covers bad points in credit capability of debtor's company. Collateral is related to any means (in assets) available to the debtor as specific guaranty for the credit pay-back. In our example collateral is taken by the expert system as an incoming parameter of analysis with values yes or no.

**Conditions** or economical conditions of managing are, at the first line, related to conjuncture at the debtor's market. In the example the most important are projections in the period of pay-back of credit. Those projections give values of satisfactory or unsatisfactory conjuncture to the expert system.

**Z-Score** analysis is specific method of measurement of debtor's financial difficulties and, at the same time, the risk of the bank. Substance of the analysis is in anticipation of reality of debtor's financial position based on use of precise indicators, where these indicators do not replace but supplement previously mentioned indicators.

Z-Score analysis is based on example of American middle large companies and it overcomes a gap between coefficient of conventional credit analysis and exact parameters taken on the base of statistical multivariancy method of analysis of debtors bonity. Z-indicator of credit quality is calculated from the following relation: <sup>(110)</sup>

$$Z = 1,2x_1 + 1,4x_2 + 3,3x_3 + 0,6x_4 + 1,0x_5, \quad \text{where:}$$

- $x_1$  = current assets / total assets
- $x_2$  = nto profit / total assets
- $x_3$  = bto profit / total assets
- $x_4$  = market value of capital / bookkeeping value of total obligations
- $x_5$  = realization / total assets.

Critical values of Z indicator are:

$Z > 2,98$  high performances of debtor business  
 $1,81 < Z < 2,99$  minimal debtor's performances  
 $Z < 1,82$  debtor's bankruptcy.  
Based on the values of Z-indicator expert system produces marks excellent, good or bad. This

indicator has eliminating character in evaluation of debtor's credit capability.

## **2. REALIZATION OF PROTOTYPE OF EXPERT SYSTEM FOR EVALUATION OF DEBTOR'S CREDIT CAPABILITY**

### **2.1. Shell VPEXPERT**

VPEXPERT is software package - shell for development of expert systems. It was developed in 1984 by Paperback Software International. During further development some modifications have been made. The package has communications with a number of programs for business processing.

VPEXPERT functions on PC and it is relatively simple for use. Besides other possibilities it has also possibility of self-education. Because of that it is classified in group of simple applications of artificial intelligence. It is quick and strong tool for the development of expert system and it uses rules which are very similar to English language.

It enables preparation of individual expert systems and quick preparation of prototypes which can be further expanded to the bigger systems. It also has possibility of communication (acceptance and sending of data) with databases (dBASE and VP-Info), with spreadsheet programs (Lotus and VP-Planner), ASCII files and some executive programs. VPEXPERT, as every other shell, contains two parts:

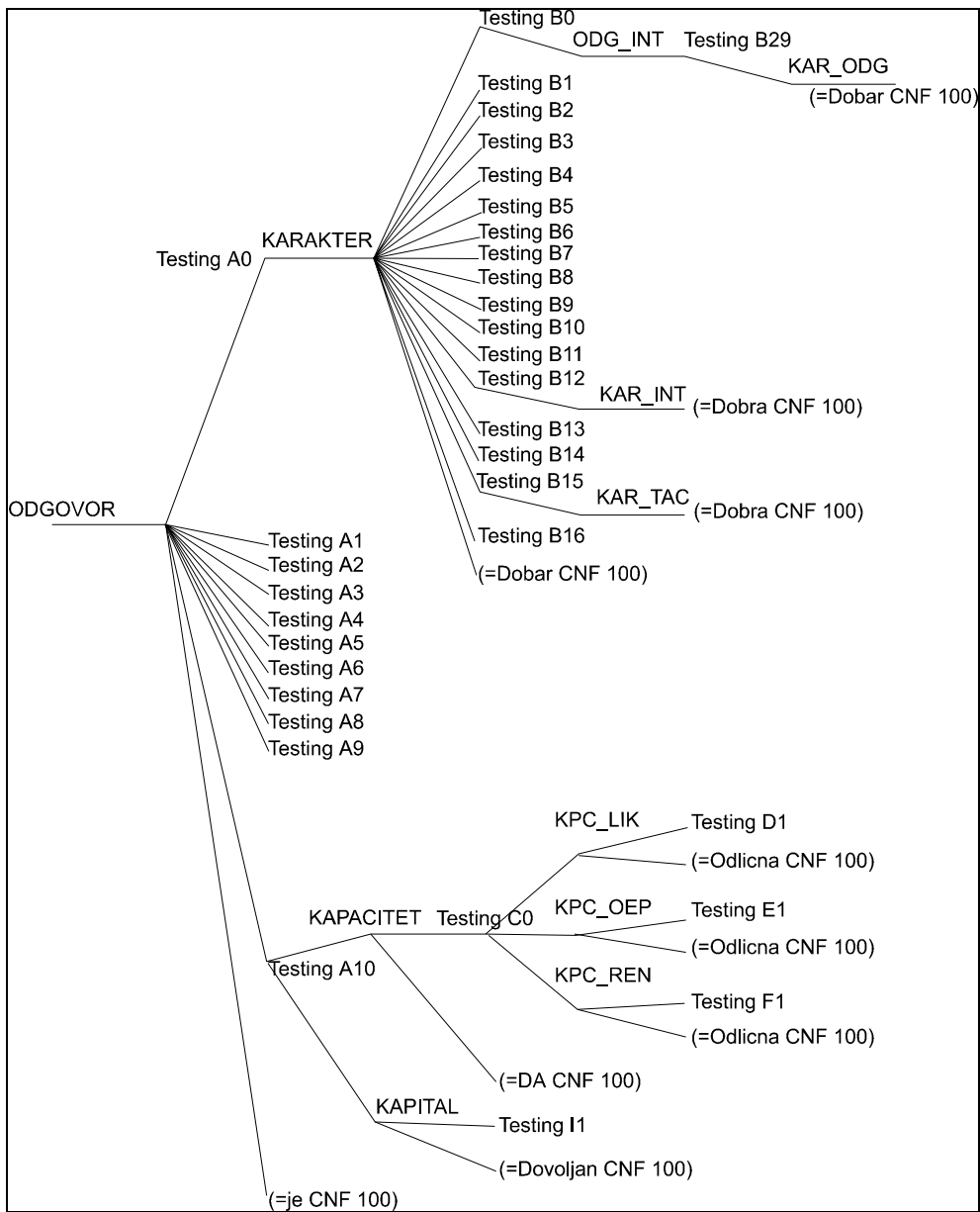
- base of knowledge (collection of information and data connected with rule of type IF - THEN) and
- mechanism of concluding (program which executes rules and operates with data, and finally makes conclusions)

VPEXPERT can be combined with external data, so that base of knowledge can be modified (enlarged) without modification of the expert system itself.

Communication with the user is very comfortable, user can choose suggested answer, he can give his own answer, he can determine percentage of reliability of the answer, and that everything in a very accessible mode of communication.

Although the shell has its own text editor, expert system in VPEXPERT can be created with any text editor or text processor. The file should only have name with extension .KBS.

### **2.2. Branch of decision in graphic form**



### 2.3. Branch of decision in text form

Testing kredit.kbs	! ! ! ! ! ! ! ! (= Good CNF
(= yes CNF 0 )	100 )
! KREDIT	! ! ! ! Testing B1
! ! (= 4000000 CNF 100)	! ! ! ! Testing B2
! IMOVINA	! ! ! ! Testing B3
! ! (= 113064000 CNF 100)	! ! ! ! Testing B4
! TAKT	! ! ! ! Testing B5
! ! (= 46889000 CNF 100)	! ! ! ! Testing B6
! TOBA	! ! ! ! Testing B7
! ! (= 3710000 CNF 100)	! ! ! ! Testing B8
! TZAL	! ! ! ! Testing B9
! ! (= 1195000 CNF 100)	! ! ! ! Testing B10
! GR	! ! ! ! Testing B11
! ! (= 6105000 CNF 100)	! ! ! ! Testing B12
! POZ	! ! ! ! ! KAR_INT
! ! (= 906000 CNF 100)	! ! ! ! ! (= Good CNF 100 )
! PPP	! ! ! ! Testing B13
! ! (= 600000 CNF 100)	! ! ! ! Testing B14
! GPRI	! ! ! ! Testing B15
! ! (= 6865000 CNF 100)	! ! ! ! ! KAR_TAC
! GTRO	! ! ! ! ! (= Good CNF 100 )
! ! (= 4817000 CNF 100)	! ! ! ! Testing B16
! GPOR	! ! ! ! (= Good CNF 100 )
! ! (= 103000 CNF 100)	! ! Testing A1
! TDUG	! ! Testing A2
! ! (= 3734000 CNF 100)	! ! Testing A3
! UAKT	! ! Testing A4
! ! (= 48282000 CNF 100)	! ! Testing A5
! TVKAP	! ! Testing A6
! ! (= 113064000 CNF 100)	! ! Testing A7
! KVUOB	! ! Testing A8
! ! (= 3734000 CNF 100)	! ! Testing A9
(= ((TAKT-TZAL)/TOBA) CNF 100 )	! ! Testing A10
(= (TAKT/TOBA) CNF 100 )	! ! ! KAPACITET
(= (GR/POZ) CNF 100 )	! ! ! ! Testing C0
(= (GR/PPP) CNF 100 )	! ! ! ! ! KPC_LIK
(= ((GPRI-GTRO-GPOR)/GR) CNF	! ! ! ! ! ! Testing D1
100 )	! ! ! ! ! ! (= Excellent CNF 100
(= (TDUG/TAKT) CNF 100 )	)
(= (GPRI-GTRO-GPOR) CNF 100 )	! ! ! ! ! KPC_OEP
(= (GPRI+GTRP+GPOR) CNF 100 )	! ! ! ! ! ! Testing E1
(=	! ! ! ! ! ! (= Excellent CNF 100
(1.2*(TAKT/UAKT)+1.4*(NETO/UAK	)
T)+3.3*(BRUTO/UAKT)+0.6*(TVKAP	! ! ! ! ! KPC_REN
/KVUOB)+1.0*(GR/UAKT)) CNF 100	! ! ! ! ! ! Testing F1
)	! ! ! ! ! ! (= Excellent CNF 100
! ODGOVOR	)
! ! Testing A0	! ! ! ! (= YES CNF 100 )
! ! ! KARAKTER	! ! ! KAPITAL
! ! ! ! Testing B0	! ! ! ! Testing I1
! ! ! ! ! ODG_INT	! ! ! ! (= Sufficient CNF 100 )
! ! ! ! ! ! Testing B29	! ! (= it is CNF 100 )
! ! ! ! ! ! ! KAR_ODG	

## 2.4. Original text of prototype of expert system KREDIT.KBS

```
! KREDIT.KBS
ENDOFF;

! Block of Actions
ACTIONS
  CLS
! Block for recording of variables
and defining necessary relations
  FIND KREDIT
  FIND IMOVINA
  FIND TAKT
  FIND TOBA
  FIND TZAL
  FIND GR
  FIND POZ
  FIND PPP
  FIND GPRI
  FIND GTRO
  FIND GPOR
  FIND TDUG
  FIND UAKT
  FIND TVKAP
  FIND KVUOB
  SFA=((TAKT-TZAL)/TOBA)
  STA=(TAKT/TOBA)
  KOZ=(GR/POZ)
  KPG=(GR/PPP)
  REN=((GPRI-GTRO-
GPOR)/GR)
  ZAD=(TDUG/TAKT)
  NETO=(GPRI-GTRO-GPOR)
  BRUTO=(GPRI+GTRP+GPOR)
  Z=(1.2*(TAKT/UAKT)+1.4*(NETO/UA
KT)+3.3*(BRUTO/UAKT)+0.6*(TVKA
P/KVUOB)+1.0*(GR/UAKT))
! Action which starts mechanism
of deciding
  FIND ODGOVOR
! Display of results of deciding
  DISPLAY "Debtor {ODGOVOR}
credit capable!"
  ;

! Block of rules
! A rules - Final part of deciding
incorporates 5 base criterions
RULE A0
IF      KARAKTER=Excellent AND
        KAPACITET=YES AND
        KAPITAL=Sufficient
THEN   ODGOVOR=it is;

RULE A1
IF      KARAKTER=Excellent AND
        KAPACITET=YES AND
        KAPITAL=Not_sufficient
AND
        KOLATERAL=YES
THEN   ODGOVOR=it is;

RULE A2
IF      KARAKTER=Excellent AND
        KAPACITET=YES AND
        KAPITAL=Not_sufficient
AND
        KOLATERAL=NO AND
        KONJUKTURA=Favorable
THEN   ODGOVOR=it is;

RULE A3
IF      KARAKTER=Excellent AND
        KAPACITET=YES AND
        KAPITAL=Not_sufficient
AND
        KOLATERAL=NO AND
        KONJUKTURA=Bad
THEN   ODGOVOR=it isn't;

RULE A4
IF      KARAKTER=Excellent AND
        KAPACITET=NO AND
        KAPITAL=Sufficient AND
        KOLATERAL=YES
THEN   ODGOVOR=it is;

RULE A5
IF      KARAKTER=Excellent AND
        KAPACITET=NO AND
        KAPITAL=Sufficient AND
        KOLATERAL=NO AND
        KONJUKTURA=Favorable
THEN   ODGOVOR=it is;

RULE A6
IF      KARAKTER=Excellent AND
        KAPACITET=NO AND
        KAPITAL=Sufficient AND
        KOLATERAL=NO AND
        KONJUKTURA=Bad
THEN   ODGOVOR=it isn't;

RULE A7
IF      KARAKTER=Excellent AND
        KAPACITET=NO AND
        KAPITAL=Not_sufficient
AND
        KOLATERAL=YES AND
        KONJUKTURA=Favorable
```

THEN ODGOVOR=it is;

RULE A8

IF KARAKTER=Excellent AND  
KAPACITET=NO AND  
KAPITAL=Not\_sufficient

AND

KOLATERAL=YES AND  
KONJUKTURA=Bad

THEN ODGOVOR=it isn't;

RULE A9

IF KARAKTER=Excellent AND  
KAPACITET=NO AND  
KAPITAL=Not\_sufficient

AND

KOLATERAL=NO

THEN ODGOVOR=it isn't;

RULE A10

IF KARAKTER=Good AND  
KAPACITET=YES AND  
KAPITAL=Sufficient

THEN ODGOVOR=it is;

RULE A11

IF KARAKTER=Good AND  
KAPACITET=YES AND  
KAPITAL=Not\_sufficient

AND

KOLATERAL=YES

THEN ODGOVOR=it is;

RULE A12

IF KARAKTER=Good AND  
KAPACITET=YES AND  
KAPITAL=Not\_sufficient

AND

KOLATERAL=NO AND  
KONJUKTURA=Favorable

THEN ODGOVOR=it is;

RULE A13

IF KARAKTER=Good AND  
KAPACITET=YES AND  
KAPITAL=Not\_sufficient

AND

KOLATERAL=NO AND  
KONJUKTURA=Bad

THEN ODGOVOR=it isn't;

RULE A14

IF KARAKTER=Good AND  
KAPACITET=NO AND  
KAPITAL=Sufficient AND  
KOLATERAL=YES

THEN ODGOVOR=it is;

RULE A15

IF KARAKTER=Good AND  
KAPACITET=NO AND  
KAPITAL=Sufficient AND  
KOLATERAL=NO AND  
KONJUKTURA=Favorable

THEN ODGOVOR=it is;

RULE A16

IF KARAKTER=Good AND  
KAPACITET=NO AND  
KAPITAL=Sufficient AND  
KOLATERAL=NO AND  
KONJUKTURA=Bad

THEN ODGOVOR=it isn't;

RULE A17

IF KARAKTER=Good AND  
KAPACITET=NO AND  
KAPITAL=Not\_sufficient

AND

KOLATERAL=YES AND  
KONJUKTURA=Favorable

THEN ODGOVOR=it is;

RULE A18

IF KARAKTER=Good AND  
KAPACITET=NO AND  
KAPITAL=Not\_sufficient

AND

KOLATERAL=YES AND  
KONJUKTURA=Bad

THEN ODGOVOR=it isn't;

RULE A19

IF KARAKTER=Good AND  
KAPACITET=NO AND  
KAPITAL=Not\_sufficient

AND

KOLATERAL=NO

THEN ODGOVOR=it isn't;

RULE A20

IF KARAKTER=Bad AND  
KAPACITET=YES AND  
KAPITAL=Sufficient AND  
KOLATERAL=YES

THEN ODGOVOR=it is;

RULE A21

IF KARAKTER=Bad AND  
KAPACITET=YES AND  
KAPITAL=Sufficient AND  
KOLATERAL=NO AND  
KONJUKTURA=Favorable

THEN ODGOVOR=it is;

RULE A22



IF       KARAKTER=Bad AND  
          KAPACITET=YES AND  
          KAPITAL=Sufficient AND  
          KOLATERAL=NO AND  
          KONJUKTURA=Bad  
THEN     ODGOVOR=it isn't;

RULE A23

IF       KARAKTER=Bad AND  
          KAPACITET=YES AND  
          KAPITAL=Not\_sufficient  
THEN     ODGOVOR=it isn't;

RULE A24

IF       KARAKTER=Bad AND  
          KAPACITET=NO  
THEN     ODGOVOR=it isn't;

**! B rules - Checking of debtor's character**

RULE B0

IF       ODG\_INT=yes AND  
          KAR\_TAC=Excellent AND  
          KAR\_DOS<>Bad  
THEN     KARAKTER=Excellent;

RULE B1

IF       ODG\_INT=yes AND  
          KAR\_TAC=Excellent AND  
          KAR\_DOS=Bad  
THEN     KARAKTER=Good;

RULE B2

IF       ODG\_INT=yes AND  
          KAR\_TAC=Good AND  
          KAR\_DOS<>Bad  
THEN     KARAKTER=Excellent;

RULE B3

IF       ODG\_INT=yes AND  
          KAR\_TAC=Good AND  
          KAR\_DOS=Bad  
THEN     KARAKTER=Good;

RULE B4

IF       ODG\_INT=yes AND  
          KAR\_TAC=Bad  
THEN     KARAKTER=Good;

RULE B5

IF       KAR\_ODG=Excellent AND  
          KAR\_INT=Good AND  
          KAR\_TAC=Excellent AND  
          KAR\_DOS<>Bad  
THEN     KARAKTER=Excellent;

RULE B6

IF       KAR\_ODG=Excellent AND

          KAR\_INT=Good AND  
          KAR\_TAC=Excellent AND  
          KAR\_DOS=Bad  
THEN     KARAKTER=Good;

RULE B7

IF       KAR\_ODG=Excellent AND  
          KAR\_INT=Good AND  
          KAR\_TAC=Good AND  
          KAR\_DOS=Excellent  
THEN     KARAKTER=Excellent;

RULE B8

IF       KAR\_ODG=Excellent AND  
          KAR\_INT=Good AND  
          KAR\_TAC=Good AND  
          KAR\_DOS<>Excellent  
THEN     KARAKTER=Good;

RULE B9

IF       KAR\_ODG=Excellent AND  
          KAR\_INT=Good AND  
          KAR\_TAC=Bad  
THEN     KARAKTER=Good;

RULE B10

IF       KAR\_ODG=Excellent AND  
          KAR\_INT=Bad AND  
          KAR\_TAC<>Bad  
THEN     KARAKTER=Good;

RULE B11

IF       KAR\_ODG=Excellent AND  
          KAR\_INT=Bad AND  
          KAR\_TAC=Bad  
THEN     KARAKTER=Bad;

RULE B12

IF       KAR\_ODG=Good AND  
          KAR\_INT=Excellent AND  
          KAR\_TAC=Excellent  
THEN     KARAKTER=Excellent;

RULE B13

IF       KAR\_ODG=Good AND  
          KAR\_INT=Excellent AND  
          KAR\_TAC=Good  
THEN     KARAKTER=Good;

RULE B14

IF       KAR\_ODG=Good AND  
          KAR\_INT=Excellent AND  
          KAR\_TAC=Bad  
THEN     KARAKTER=Good;

RULE B15

IF       KAR\_ODG=Good AND  
          KAR\_INT=Good AND

KAR\_TAC=Excellent  
THEN KARAKTER=Good;

RULE B16

IF KAR\_ODG=Good AND  
KAR\_INT=Good AND  
KAR\_TAC=Good  
THEN KARAKTER=Good;

RULE B17

IF KAR\_ODG=Good AND  
KAR\_INT=Good AND  
KAR\_TAC=Bad AND  
KAR\_DOS<>Bad  
THEN KARAKTER=Good;

RULE B18

IF KAR\_ODG=Good AND  
KAR\_INT=Good AND  
KAR\_TAC=Bad AND  
KAR\_DOS=Bad  
THEN KARAKTER=Bad;

RULE B19

IF KAR\_ODG=Good AND  
KAR\_INT=Bad AND  
KAR\_TAC=Excellent  
THEN KARAKTER=Good;

RULE B20

IF KAR\_ODG=Good AND  
KAR\_INT=Bad AND  
KAR\_TAC=Good AND  
KAR\_DOS<>Bad  
THEN KARAKTER=Good;

RULE B21

IF KAR\_ODG=Good AND  
KAR\_INT=Bad AND  
KAR\_TAC=Good AND  
KAR\_DOS=Bad  
THEN KARAKTER=Bad;

RULE B22

IF KAR\_ODG=Good AND  
KAR\_INT=Bad AND  
KAR\_TAC=Bad  
THEN KARAKTER=Bad;

RULE B23

IF KAR\_ODG=Bad AND  
KAR\_INT=Excellent AND  
KAR\_TAC<>Bad  
THEN KARAKTER=Good;

RULE B24

IF KAR\_ODG=Bad AND  
KAR\_INT=Excellent AND

KAR\_TAC=Bad AND  
KAR\_DOS<>Bad  
THEN KARAKTER=Good;

RULE B25

IF KAR\_ODG=Bad AND  
KAR\_INT=Excellent AND  
KAR\_TAC=Bad AND  
KAR\_DOS=Bad  
THEN KARAKTER=Bad;

RULE B26

IF KAR\_ODG=Bad AND  
KAR\_INT=Good AND  
KAR\_TAC<>Bad  
THEN KARAKTER=Good;

RULE B27

IF KAR\_ODG=Bad AND  
KAR\_INT=Good AND  
KAR\_TAC=Bad  
THEN KARAKTER=Bad;

RULE B28

IF KAR\_ODG=Bad AND  
KAR\_INT=Bad  
THEN KARAKTER=Bad;

RULE B29

IF KAR\_ODG=Excellent AND  
KAR\_INT=Excellent  
THEN ODG\_INT=yes;

**! C rules - Checking of debtor's capacity**

RULE C0

IF KPC\_LIK=Excellent AND  
KPC\_OEP=Excellent AND  
KPC\_REN <> Bad  
THEN KAPACITET=YES;

RULE C1

IF KPC\_LIK=Excellent AND  
KPC\_OEP=Excellent AND  
KPC\_REN=Bad AND  
ZAD\_ZSC=yes  
THEN KAPACITET=YES;

RULE C2

IF KPC\_LIK=Excellent AND  
KPC\_OEP=Excellent AND  
KPC\_REN=Bad AND  
KPC\_ZAD=Good AND  
KPC\_ZSC=Good  
THEN KAPACITET=YES;

RULE C3

IF KPC\_LIK=Excellent AND  
KPC\_OEP=Excellent AND

KPC\_REN=Bad AND  
KPC\_ZAD=Good AND  
KPC\_ZSC=Bad  
THEN KAPACITET=NO;

RULE C4  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Excellent AND  
KPC\_REN=Bad AND  
KPC\_ZAD=Bad AND  
KPC\_ZSC=Excellent  
THEN KAPACITET=YES;

RULE C5  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Excellent AND  
KPC\_REN=Bad AND  
KPC\_ZAD=Bad AND  
KPC\_ZSC=Good  
THEN KAPACITET=NO;

RULE C6  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Excellent AND  
KPC\_REN=Bad AND  
KPC\_ZAD=Bad AND  
KPC\_ZSC=Bad  
THEN KAPACITET=NO;

RULE C7  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Good AND  
KPC\_REN=Excellent  
THEN KAPACITET=YES;

RULE C8  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Good AND  
KPC\_REN=Good AND  
ZAD\_ZSC=yes  
THEN KAPACITET=YES;

RULE C9  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Good AND  
KPC\_REN=Good AND  
KPC\_ZAD=Good AND  
KPC\_ZSC=Good  
THEN KAPACITET=YES;

RULE C10  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Good AND  
KPC\_REN=Good AND  
KPC\_ZAD=Good AND  
KPC\_ZSC=Bad  
THEN KAPACITET=NO;

RULE C11  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Good AND  
KPC\_REN=Good AND  
KPC\_ZAD=Bad AND  
KPC\_ZSC=Excellent  
THEN KAPACITET=YES;

RULE C12  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Good AND  
KPC\_REN=Good AND  
KPC\_ZAD=Bad AND  
KPC\_ZSC=Good  
THEN KAPACITET=NO;

RULE C13  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Good AND  
KPC\_REN=Good AND  
KPC\_ZAD=Bad AND  
KPC\_ZSC=Bad  
THEN KAPACITET=NO;

RULE C14  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Good AND  
KPC\_REN=Bad  
THEN KAPACITET=NO;

RULE C15  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Bad AND  
KPC\_REN=Excellent AND  
ZAD\_ZSC=yes  
THEN KAPACITET=YES;

RULE C16  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Bad AND  
KPC\_REN=Excellent AND  
KPC\_ZAD=Good AND  
KPC\_ZSC=Good  
THEN KAPACITET=YES;

RULE C17  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Bad AND  
KPC\_REN=Excellent AND  
KPC\_ZAD=Good AND  
KPC\_ZSC=Bad  
THEN KAPACITET=NO;

RULE C18  
IF KPC\_LIK=Excellent AND  
KPC\_OEP=Bad AND  
KPC\_REN=Excellent AND  
KPC\_ZAD=Bad AND

KPC\_ZSC=Excellent  
THEN  KAPACITET=YES;

RULE C19

IF      KPC\_LIK=Excellent AND  
          KPC\_OEP=Bad AND  
          KPC\_REN=Excellent AND  
          KPC\_ZAD=Bad AND  
          KPC\_ZSC=Good  
THEN  KAPACITET=NO;

RULE C20

IF      KPC\_LIK=Excellent AND  
          KPC\_OEP=Bad AND  
          KPC\_REN=Excellent AND  
          KPC\_ZAD=Bad AND  
          KPC\_ZSC=Bad  
THEN  KAPACITET=NO;

RULE C21

IF      KPC\_LIK=Excellent AND  
          KPC\_OEP=Bad AND  
          KPC\_REN<>Excellent  
THEN  KAPACITET=NO;

RULE C22

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Excellent AND  
          KPC\_REN=Excellent  
THEN  KAPACITET=YES;

RULE C23

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Excellent AND  
          KPC\_REN=Good AND  
          ZAD\_ZSC=yes  
THEN  KAPACITET=YES;

RULE C24

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Excellent AND  
          KPC\_REN=Good AND  
          KPC\_ZAD=Good AND  
          KPC\_ZSC=Good  
THEN  KAPACITET=YES;

RULE C25

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Excellent AND  
          KPC\_REN=Good AND  
          KPC\_ZAD=Good AND  
          KPC\_ZSC=Bad  
THEN  KAPACITET=NO;

RULE C26

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Excellent AND  
          KPC\_REN=Good AND  
          KPC\_ZAD=Bad AND

          KPC\_ZSC=Excellent  
THEN  KAPACITET=YES;

RULE C27

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Excellent AND  
          KPC\_REN=Good AND  
          KPC\_ZAD=Bad AND  
          KPC\_ZSC<>Excellent  
THEN  KAPACITET=NO;

RULE C29

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Excellent AND  
          KPC\_REN=Bad  
THEN  KAPACITET=YES;

RULE C30

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Good AND  
          KPC\_REN=Excellent AND  
          KPC\_ZAD=Good AND  
          KPC\_ZSC<>Bad  
THEN  KAPACITET=YES;

RULE C32

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Good AND  
          KPC\_REN=Excellent AND  
          KPC\_ZAD=Good AND  
          KPC\_ZSC=Bad  
THEN  KAPACITET=NO;

RULE C33

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Good AND  
          KPC\_REN=Excellent AND  
          KPC\_ZAD=Bad AND  
          KPC\_ZSC=Excellent  
THEN  KAPACITET=YES;

RULE C34

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Good AND  
          KPC\_REN=Excellent AND  
          KPC\_ZAD=Bad AND  
          KPC\_ZSC<>Excellent  
THEN  KAPACITET=NO;

RULE C36

IF      KPC\_LIK=Good AND  
          KPC\_OEP=Good AND  
          KPC\_REN=Good AND  
          KPC\_ZAD=Good AND  
          KPC\_ZSC<>Bad  
THEN  KAPACITET=YES;

RULE C38

IF KPC\_LIK=Good AND  
 KPC\_OEP=Good AND  
 KPC\_REN=Good AND  
 KPC\_ZAD=Good AND  
 KPC\_ZSC=Bad  
 THEN KAPACITET=NO;

RULE C39  
 IF KPC\_LIK=Good AND  
 KPC\_OEP=Good AND  
 KPC\_REN=Good AND  
 KPC\_ZAD=Bad  
 THEN KAPACITET=NO;

RULE C40  
 IF KPC\_LIK=Good AND  
 KPC\_OEP=Good AND  
 KPC\_REN=Bad  
 THEN KAPACITET=NO;

RULE C41  
 IF KPC\_LIK=Good AND  
 KPC\_OEP=Bad  
 THEN KAPACITET=NO;

RULE C42  
 IF KPC\_LIK=Bad  
 THEN KAPACITET=NO;

RULE C43  
 IF KPC\_ZAD=Good AND  
 KPC\_ZSC=Excellent  
 THEN ZAD\_ZSC=yes;

**! D rules - checking of debtor's liquidity in frame of checking of capacity**

RULE D1  
 IF SFA >= (1.0)  
 THEN KPC\_LIK=Excellent;

RULE D2  
 IF SFA < (1.0) AND  
 STA > (1.0)  
 THEN KPC\_LIK=Good;

RULE D3  
 IF STA <= (1.0)  
 THEN KPC\_LIK=Bad;

**! E rules - Checking of debtor's efficiency in frame of checking of capacity**

RULE E1  
 IF KOZ >= (0.75) AND  
 KPG >= (1.0)  
 THEN KPC\_OEP=Excellent;

RULE E2  
 IF KOZ >= (0.75) AND  
 KPG < (1.0)  
 THEN KPC\_OEP=Good;

RULE E3  
 IF KOZ < (0.75) AND  
 KOZ > (0.5) AND  
 KPG > (1.0)  
 THEN KPC\_OEP=Good;

RULE E4  
 IF KOZ < (0.75) AND  
 KPG < (1.0)  
 THEN KPC\_OEP=Bad;

RULE E5  
 IF KOZ <= (0.5)  
 THEN KPC\_OEP=Bad;

**! F rules - Checking of debtor's rentability in frame of checking of capacity**

RULE F1  
 IF REN > (0.3)  
 THEN KPC\_REN=Excellent;

RULE F2  
 IF REN <= (0.3) AND  
 REN >= (0.1)  
 THEN KPC\_REN=Good;

RULE F3  
 IF REN < (0.1)  
 THEN KPC\_REN=Bad;

**! G rules - Checking of debtor's debt in frame of checking of capacity**

RULE G1  
 IF ZAD <= (0.25)  
 THEN KPC\_ZAD=Good;  
 RULE G2  
 IF ZAD > (0.25)  
 THEN KPC\_ZAD=Bad;

**! H rules - checking of Z-score in frame of checking of capacity**

RULE H1  
 IF Z >= (2.99)  
 THEN KPC\_ZSC=Excellent;

RULE H2  
 IF Z >= (1.81) AND  
 Z < (2.99)  
 THEN KPC\_ZSC=Good;

RULE H3

IF Z < 1.81  
THEN KPC\_ZSC=Bad;

**! I rules - Checking of debtor's capital**

RULE I1  
IF IMOVINA >= (KREDIT)  
THEN KAPITAL=Sufficient;

RULE I2  
IF IMOVINA < (KREDIT)  
THEN KAPITAL=Not\_sufficient;

**! Block of statements**

**! Defining of questions for recording of variables and possible values of variables**

ASK KOLATERAL: "Is there any collateral?";  
CHOICES KOLATERAL: YES, NO;  
ASK KONJUKTURA: "What is conjuncture?";  
CHOICES KONJUKTURA:  
Favorable, Bad;  
ASK KAR\_ODG: "Evaluation of top manager - owner of company?";  
CHOICES KAR\_ODG:  
Excellent,Good,Bad;  
ASK KAR\_INT: "Business experience with debtor?";  
CHOICES KAR\_INT:  
Excellent,Good,Bad;  
ASK KAR\_TAC: "Fulfilling of obligations at time?";

CHOICES KAR\_TAC:  
Excellent,Good,Bad;  
ASK KAR\_DOS: "State of bookkeeping?";  
CHOICES KAR\_DOS:  
Excellent,Good,Bad;  
ASK TAKT: "What is current assets?";  
ASK TOBA: "What are current obligations?";  
ASK TZAL: "What is current stock?";  
ASK GR: "What is annual realization?";  
ASK POZ: "What is average volume of stock?";  
ASK PPP: "What are average demands?";  
ASK GPRI: "What is annual input?";  
ASK GTRO: "What are annual costs?";  
ASK GPOR: "What is taxes?";  
ASK TDUG: "What are current debts?";  
ASK UAKT: "What is total assets?";  
ASK TVKAP: "What is market value of capital?";  
ASK KVVUOB: "What is bookkeeping value of total obligations?";  
ASK KREDIT: "How big loan do you need?";  
ASK IMOVINA: "What is nto value of total capital?";

## 2.5. Appearance of screen for recording of variables:

48282000

What is market value of capital?  
113064000

What is bookkeeping value of total obligations?  
3734000

Evaluation of top manager - owner of company?  
Excellent      **Good**      Bad

Finding ODG_INT Testing B29 RULE B29 IF KAR_ODG = Excellent AND KAR_INT = Excellent THEN ODG_INT = yes CNF 100 Finding KAR_ODG	STA = (TAKT/TOBA) CNF 100 KOZ = (GR/POZ) CNF 100 KPG = (GR/PPP) CNF 100 REN = ((GPRI-GTRO-GPOR)/GR CNF 100 ZAD = (TDUG/TAKT) CNF 100 NETO = (GPRI-GTRO-GPOR) CNF 100 BRUTO = (GPRI+GTRP+GPOR) CNF 100 Z = (1.2*(TAKT/UAKT)+1.4 CNF 100
---	---

Enter to select    END to complete    /Q to Quit    ? for Unknown

Excellent      **Good**      Bad

Business experiences with debtor ?  
Excellent      **Good**      Bad

Fulfilling of obligations at time?  
Excellent      **Good**      Bad

**Debtor is credit capable!**

THEN KPC_REN = Excellent CNF 100 Finding KAPITAL Testing I1 RULE I1 IF IMOVINA >= KREDIT THEN KAPITAL = Sufficient CNF 100	KAR_TAC = Good CNF 100 KARAKTER = Good CNF 100 KPC_LIK = Excellent CNF 100 KPC_OEP = Excellent CNF 100 KPC_REN = Excellent CNF 100 KAPACITET = YES CNF 100 KAPITAL = Sufficient CNF 100 ODGOVOR = it is CNF 100
--	--

1Help    2Go    3WhatIf    4Variable    5Rule    6Set    7Edit    8Quit  
 1Help 2How? 3Why? 4Slow 5Fast 6Quit

Excellent	<b>Good</b>	Bad
Is there any collateral ?		
<b>YES</b>	NO	
What is conjuncture ?		
<b>Favorable</b>	Bad	
<b><u>Debtor is credit capable!</u></b>		

KAPACITET = NO AND KAPITAL = Not_sufficient AND KOLATERAL = YES AND KONJUKTURA = Favorable THEN ODGOVOR = it is CNF 100 Finding KOLATERAL Finding KONJUKTURA	KARAKTER = Good CNF 100 KPC_LIK = Good CNF 100 KPC_OEP = Bad CNF 100 KAPACITET = NO CNF 100 KAPITAL = Not_sufficient CNF 100 KOLATERAL = YES CNF 100 KONJUKTURA = Favorable CNF 100 ODGOVOR = it is CNF 100
---	--

1Help 2Go 3WhatIf 4Variable 5Rule 6Set 7Edit 8Quit 1Help 2How? 3Why? 4Slow 5Fast 6Quit
---

<b>Excellent</b>	Good	Bad
Fulfilling of obligations at time?		
Excellent	Good	<b>Bad</b>
State of bookkeeping?		
Excellent	Good	<b>Bad</b>
Is there any collateral?		
YES	<b>NO</b>	

KAPACITET = YES CNF 100 Finding KAPITAL Testing I1 RULE I1 IF IMOVINA >= KREDIT THEN KAPITAL = Sufficient CNF 100 Finding KOLATERAL	KAR_TAC = Bad CNF 100 KAR_DOS = Bad CNF 100 KARAKTER = Bad CNF 100 KPC_LIK = Good CNF 100 KPC_OEP = Excellent CNF 100 KPC_REN = Bad CNF 100 KAPACITET = YES CNF 100 KAPITAL = Sufficient CNF 100
--	---

Enter to select END to complete /Q to Quit ? for Unknown
--



